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SHAD FISHERY OF THE OGEECHEE RIVER, GEORGIA, IN 1954

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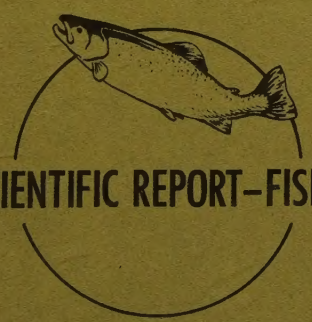

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EXPLANATORY NOTE

The series embodies results of investigations, usually of restricted scope, intended to aid or direct management or utilization practices and as guides for administrative or legislative action. it is issued in limited quantities for official use of Federal, State or cooperating agencies and in processed form for economy and to avoid delay in publication.

United States Department of the Interior, Fred A. Seaton, Secretary
Fish and Wildlife Service, John L. Farley, Director

SHAD FISHERY OF THE OGEECHEE RIVER, GEORGIA, IN 1954

by

James E. Sykes
Fishery Research Biologist

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ABSTRACT

Investigation of the Ogeechee River (Georgia) shad fishery is part of a coastwise study of the American shad (Alosa sapidissima) sponsored by the Atlantic States Marine Fisheries Commission.

This report presents data on the 1954 shad fishery of the Ogeechee River, with respect to analysis of catch, fishing effort, and tagging data used to estimate total population, fishing rate, and spawning escapement. A spawning-ground survey was made, and a description of the limits of this area is presented.

Recommendations are made (1) for the preservation of future shad runs, which may be threatened if textile mills are constructed along the lower Ogeechee, and (2) for the procurement of yearly catch and effort data which could be used in conjunction with this study to determine factors affecting shad abundance. If these factors can be determined and controlled, a management policy for the Ogeechee River shad fishery can be established.

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SHAD FISHERY OF THE OGEECHEE RIVER, GEORGIA, IN 1954

An investigation of American shad (Alosa sapidissima) is being conducted by the U. S. Fish and Wildlife Service in cooperation with the individual State fishery agencies along the Atlantic coast. The present phase of the study, which began in 1950, is sponsored by the Atlantic States Marine Fisheries Commission. The purposes are (1) to determine the underlying causes of a general decline in shad production along the coast, (2) to determine factors favoring recovery, and (3) to provide basic information whereby each fishery may be managed to obtain a maximum sustained yield.

Shad are hatched in the fresh-water sections of many Atlantic-coast rivers in the spring. They spend their first summer in these rivers and migrate to the ocean in the fall. Sexual maturity is reached 3 to 6 years later, at which time they reenter the rivers to spawn.

This report concerns a study, undertaken in 1954, of the shad fishery of the Ogeechee River in Georgia. It deals primarily with the determination of fishing rate, fishing effort, total catch, and estimates of size of run and of spawning escapement.

Appreciation is expressed to the staff of the U. S. Fishery Laboratory, Beaufort, North Carolina, for help in obtaining data; to David Gould, Supervisor, Coastal Fisheries, and to Fred J. Dickson, Chief, Fish Management, of the Georgia State Game and Fish Commission, for furnishing license lists, and to the shad fishermen and dealers who cooperated in furnishing catch records.

Description of the river

The Ogeechee River rises in Green County, Georgia, and flows southeastward about 350 miles to Ossabaw Sound, south of Savannah, Georgia. It is a meandering stream, particularly below its junction with the Canoochee River, 25 miles from its mouth, (figs. 1 and 2). The Canoochee does not support a shad run. The Ogeechee is one of the few remaining east-coast rivers virtually unaffected by domestic or industrial pollution. It is relatively free from silt at all times.

At the present time the river is devoid of dams and other obstructions that would block the passage of shad. Shad ascend the river at least 125 miles to the vicinity of Midville. Industry could alter both the water quality and the extent of migration unless precautions are taken. The location of textile plants 5 miles below Kings Ferry (U. S. Highway 17) is being considered. It is possible that a low-head dam will be built in conjunction with the plants. Discharge of toxic effluents into the river and/or blocking of the river by a dam would have a serious effect upon the shad run. It is suggested that before industrial development is authorized facilities be planned for the treatment of any toxic effluent to be discharged into the river. Also, any proposed dam should in clude adequate facilities for the safe passage of fish.

The commercial fishery

The commercial shad fishery extends from the mouth of the river to Midville. Drift and set gill nets are the only types of gear employed. Most full-time commercial fishing takes place in a 25-mile section of the river from its mouth to approximately 7 miles above Kings Ferry, while part-time fishing takes place above Kings Ferry. The minimum legal mesh size for both types of net is 4-1/2 inches, stretched measure. Most fishermen used 5-1/2-inch stretched mesh and have changed from linen to nylon nets within the past 5 years.

The commercial fishing season begins January 1 and ends April 15. The fishing week extends from sunrise on Monday to sundown on Friday. During the 1954 season shad did not appear in substantial numbers until the first week of February, and commercial fish-

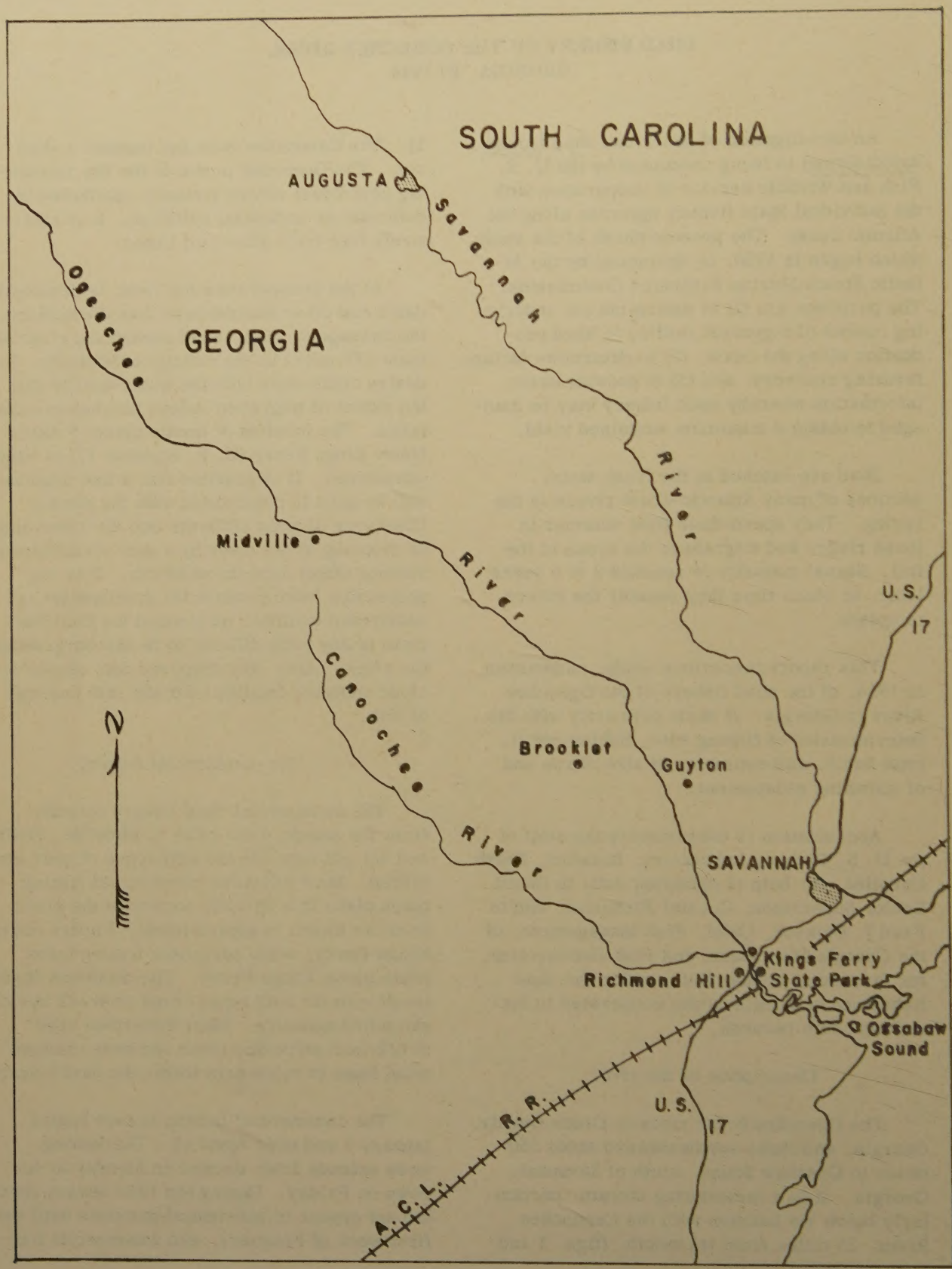

Figure 1.--Ogeechee River.

Figure 2.--Aerial view of Ogeechee River between mouth and Kings Ferry.

ing all but stopped 2 weeks before the closure date because of poor catches.

The jurisdiction of the Coastal Fisheries Division of the Georgia State Game and Fish Commission extends from the mouth of the river to the Atlantic Coast Line Railroad bridge, 1 mile below Kings Ferry. Fishing from this point upriver comes under the authority of the Inland Division of the Commission. The two areas have been designated as coastal and inland fishing areas and are referred to as such in this report.

The only commercial gear fished in the coastal area are drift gill nets, averaging 100 yards in length and 18 feet in depth. Most drifting is done on flood tide, and the average length of time per drift is 30 minutes. There were 15 drift nets used in this area in 1954. When the fishing season was at its peak, these fishermen made as many as 13 drifts each day. Shad taken by these nets are sold to dealers in Savannah.

The inland fishing area can be divided into two sectors based on the type of gear fished. The lower inland sector, known as the Kings Ferry set-net fishery, extends from Kings Ferry upriver for a distance of approximately 7 miles. Only set nets are fished in this sector, while in the upper inland sector there is an interspersion of set and drift nets. These will be referred to as upper set nets and upper drift nets.

Set nets are of the same design as drift nets, but instead of drifting with the current one end of the net is secured to a stake near the river bank while the other end is held by a heavy anchor in the river. In the Kings Ferry set-net fishery there were 40 licensed nets in 1954. They averaged 60 yards in length and 18 feet in depth. They were usually fished during flood tide for about 4 hours each legal fishing night. No daytime set net fishing was done because, according to the fishermen, clarity of the water enables shad to see the nets and avoid them.

Besides full-time fishermen engaged in the Kings Ferry fishery, residents of Savannah and vicinity who fish part time for shad set their nets here. The remainder of the inland fishery, extending upriver to Midville, is made up of part-time fishermen who derive their livelihood from other means. A few of these men sell to dealers in Savannah, but since catches are small, most of the shad are consumed locally. This fishery consisted of 182 set nets ranging in length from 5 to 60 yards and 21 drift nets ranging in length from 30 to 80 yards. The ranges in days fished by the several types of gear were 6 to 33 days for coastal drift nets, 2 to 24 days for upper drift nets, and 7 to 51 days for inland (Kings Ferry and upper) set nets. Table 1 lists the number of licensed nets in the coastal and inland areas of the river and the catches by each type of gear.

Population study

Population parameters were estimated by means of a tagging and recovery program. To obtain shad for tagging, Fish and Wildlife Service biologists fished a drift gill net near the mouth of the river below all commercial-fishing areas, beginning February 1. Petersen-type tags were used, consisting of two red plastic disks and a 4-inch nickel pin. Mail-return instructions were printed on one disk. A disk was secured to each side of the fish by the pin which was passed through the back below the dorsal fin. Each shad upon removal from the net was weighed and measured. Sex was determined by observation of size and body depth and size and shape of the vent. The body depth in females is greater in proportion to length than in males and the vent is more pronounced in females. Scale samples were taken, and each fish was tagged before being returned to the water.

All buyers of commercial shad fishing licenses were interviewed and given logbooks so that type and size of gear used, location fished, number of days fished, and catch could be recorded. Data were copied out of the logbooks once each week, and at the same time tags were redeemed for 50 cents each. Some tags were returned through the mail, partially as a result of local newspaper accounts of the research program.

Table 1.--Licensed nets and catch of the commercial fishery (full-time and part-time fishermen combined) for 1954

Fishing area and gear	Number of licensed nets	Number of shad caught
Coastal area:		
Coastal drift nets	15	9,490
Inland area:		
Kings Ferry set nets	40	4,359
Upper set nets	182	4,341
Upper drift nets	21	1,906
Total	258	20,096

We fished for tagging specimens almost every day throughout the season, because it was difficult to obtain as many live shad as desired. A total of 235 shad were tagged throughout the fishing season. During this same period 133 tags were recaptured by the commercial fishery. The calculated commercial-fishing rate in 1954 was 133/235 or 56.6 percent.

In a study of the Umpqua River in Oregon, Gharrett (1950) found that Petersen-type tags caused fish to become entangled in the gear, thus making it selective for tagged fish. Should the tags used in this study have been selective the proportion of tagged fish in the catch of the coastal area would have been greater than that of the inland area. To determine whether this occurred, the tag-recovery data from the coastal and inland areas were subjected to a chi-square test:

	Catch	Number of tagged fish in catch
Coastal area	9,730	68
Inland area	10,366	65
Total	20,096	133

$X^2 = 0.397$; $P \sim 0.50$

The analysis shows that there was no significant difference in the proportion of tagged to untagged fish in the catch of the coastal fishery compared with that of the inland fishery. Thus no evidence of selectivity was found in this study.

The following formula was used to estimate the size of the 1954 Ogeechee River shad run:

$$\hat{N} = \frac{nt}{s}$$

where

t = number of tagged shad (235)

n = number subsequently sampled (20,096)

s = number of tagged shad in sample (133)

$\hat{N}$ = estimate of total number of shad in population

The estimated population ($\hat{N}$) = 35,508 shad. Confidence limits were determined for this estimate using a method given by Chapman (1948). With 95-percent confidence, the true population was found to range between 30,000 and 42,000 shad.

By subtracting the catch from the best estimate of population size (35,508 - 20,096) the estimated escapement from the commercial fishery was 15,412 shad or 43 percent of the total run.

Standardization of effort

To determine the fishing effort of the 1954 Ogeechee River shad fishery, 100 yards of gill net was chosen as a unit of gear. One unit of gear fished for 1 day was termed 1 unit of effort or 1 net-day. Total units of effort fished, catch, and catch per unit of effort for each type of gear are given in table 2.

To obtain total fishing effort, the effort of the various types of gear must be combined. It can be seen (table 2) that the catch per unit of effort differs between types of gear. This may be attributable to a difference in fishing efficiency of each type of gear.

The fishing efficiency of the various types of gear can be determined by use of a method described by Fredin (1954). A comparison of the fishing power of the various types of gear will make standardization of fishing effort possible. Fishing power can be defined as the ability of 1 unit of gear (100 yards of gill net) to capture a certain fraction of the fish present in 1 day's fishing. This function will be designated as p and can be considered to be constant within a season and between seasons, provided (1)there is no alteration in the design or operation of fishing gear which would change its efficiency, (2) the fishing effort is uniform throughout the season, and (3) the migration pattern of shad within the river is the same each year.

The method used to determine gear efficiency is dependent upon whether (1) the fishing gears fish the same area or (2) the fishing gears fish different areas. In the first instance the fishing efficiency of each type of gear can be determined by comparing their catch-per-unit-of-effort values (Fredin, 1954) and in the second instance it can be determined by comparing their fishing power (Talbot, 1954). The coastal drift nets and Kings Ferry set nets each fish a specific area in the river, while the upper set nets and upper drift nets fish the same area. To determine the efficiency of the gears fished on the Ogeechee River, both of the foregoing methods must be used.

The catches per unit of effort of the upper set nets and upper drift nets, which fish the same area, were 10.7 and 17.6 respectively (table 2). Compared with upper drift nets, upper set nets were 0.60 times as efficient. If upper-set-net effort is converted with upper-drift-net effort (407 multiplied by 0.60) the total units of effort of the upper nets is then 352 net-days. The efforts of the upper set and drift nets were combined, and henceforth these gears will be termed "combined upper nets". We now have three classifications of gear (coastal drift nets, Kings Ferry set nets, and combined upper nets), each fishing a different area of the river. The fishing effort exerted by each of these gears in net-days is as follows: Coastal drift nets, 455; King Ferry set nets, 353; and combined upper nets, 352.

Talbot (1954), using the formula $q^n = E/N$ from Fredin (1954) shows a method for determining the fishing power (p) of gear fished in separate areas of a river. Fishing effort (net-days) is represented by n where q equals that fraction of the population escaping one net-day's fishing; E equals escapement from each type of gear; and N equals total number of fish available to each type of gear.

From the tagging experiment we estimated that the total run was 35,508 shad. Hence, that number of shad was available to the coastal drift net fishery. The number of net-days fished was 455, the catch was 9,490 shad (table 2), and the escapement from these nets was 26,018 (35,508 - 9,490), thus,

$$q^{455} = \frac{26,016}{35,508}$$ from which $q = 0.99932$ and $p = 0.00068$.

The number of fish escaping the coastal drift net fishery and therefore available to Kings Ferry set nets was 26,018. In 353 net-days, the latter nets caught 4,359 fish (table 2) and the escapement from these nets was 21,659. In this case, $q^{353} = \frac{21,659}{26,018}$ from which $q = 0.99948$, and $p = 0.00052$.

Table 2.--Total effort, catch (number of shad), and catch per unit of effort of each type of gear fished in the Ogeechee River, 1954.

Area	Effort (net-days)	Catch	Catch per unit of effort
Coastal area:			
Coastal drift net	455	9,490	20.8
Inland area:			
Kings Ferry set nets	353	4,359	12.3
Upper set nets	407	4,341	10.7
Upper drift nets	108	1,906	17.6

The number of fish escaping the Kings Ferry set nets and therefore available to the combined upper nets was 21,659. The latter nets took 6,247 fish in 352 net-days, allowing 15,412 fish to escape. Consequently,

$q^{352} = \frac{15,412}{21,659}$ from which q = 0.99903,

and p = 0.00097.

Comparing the fishing power of the Kings Ferry set nets (p = 0.00052) and the combined upper nets (p = 0.00097) to that of coastal drift nets (p = 0.00068), we find that the former two catch respectively 0.76 and 1.43 times as many fish. Now that a measure of the fishing power of each type of gear has been obtained it is possible to convert all fishing effort into standard units. A standard fishing unit (s.f.u.) day will be defined as 100 yards of coastal drift net fished for 1 day. Fishing effort (net-days) of each type gear is converted to standard fishing units by multiplying each net's effort by the following conversion factors:

	Effort (net-days)	Conversion factors	s.f.u. days
Coastal drift nets	455	1.00	455
Kings Ferry set nets	353	0.76	268
Combined upper nets	352	1.43	503
Total	---	---	1,226

Thus a total of 1,226 s.f.u. days was required to remove 20,096 shad from an available population of 35,508 shad.

By using Talbot's formula $N = \frac{C}{(1-q^n)}$ [1/] in conjunction with data obtained in this study it will be possible to determine the size of the Ogeechee River shad run for each year in which catch and effort records are obtained, provided the fishing gear continues to be fished in the same manner, fishing effort is uniform throughout season, and the migration pattern of shad within the river is the same each year.

The sport fishery

Sport fishermen catch shad on the Ogeechee River by trolling or setting lines from anchored boats. Only artificial lures are used, the principal ones being spoons and yellow feather jigs.

There is no closed season on sport-fishing for shad. The length of the season is dependent upon the duration of the run. In 1954, shad were taken by sportsmen over a period of approximately 60 days, beginning in mid-February and ending in mid-April.

1/ N = size of run, C = total catch, n = number of s.f.u. days, q is assumed to be constant from year to year.

In the area between Kings Ferry and Guyton there are 11 sport-fishing camps which rent boats. There is also a State park in this area where no boats are rented but from which private boats may be launched. At the request of Fish and Wildlife Service biologists the 11 camp operators in the Kings Ferry - Guyton area kept daily records of the number of shad fishermen and their catches. The camps are listed progressively upstream by numbers 1 to 11 in table 3.

The number of boats fishing for shad and the catches per boat were checked at the State park for a total of 19 days during the season. Each day of the week was represented in the sample. An estimate of the total season's catch was obtained by finding the average weekday, Saturday, and Sunday catch per boat in the sample and multiplying these averages by the respective number of weekday, Saturday, and Sunday boat-days which occurred in the season. An estimate of the total catch for this area is given in table 4.

Above Guyton there are no fishing camps, but between Brooklet and Midville there are four well-used landings which were spot checked on 21 days during the season. A biologist was stationed at one of the landings for the entire day to record shad as they were brought in. Each landing was visited for one weekday and for at least one weekend day each week throughout the season. An estimate of the catch in this area was derived in the same manner as that for the State park (table 4).

Based on the two estimates and the known catches recorded by the fishing-camp operators, the sport catch on the river totaled 3,405 shad or 14.5 percent of the total shad catch. Of the sport catch, 74 percent (2,528 shad) was made in the area from the State park at Kings Ferry to Guyton, and 26 percent (877) shad was made between Brooklet and Midville, the upper extremity of sport fishing. The sport fishery is an important part of the total shad fishery and should be regarded as such in any management plan for the river.

An estimate of the escapement from the commercial fishery was given previously. To obtain an estimate of the spawning escapement it was necessary to subtract the sport catch (3,405 shad) from the previously determined commercial-fishery escapement (15,412 shad). Thus our estimate of spawning escapement is 12,007 shad or 34 percent of the original population, and the overall fishing rate is then 66 percent.

Spawning area

To determine the limits of shad spawning in the Ogeechee River, egg-collecting nets were set at selected stations from 3 miles below the Atlantic Coast Line Railroad bridge to Louisville. The nets, made of nylon marquisette, were 3 meters long and had a hoop diameter of 1 meter. They were secured in the current on the river bottom by anchors. Nets were set four times throughout the season at each of 19 stations, for a period of one-half hour per set.

Sampling began on March 16 and continued through April 27. Eggs were obtained in the area from Kings Ferry to Midville (table 5). They were taken throughout the survey although with less frequency during the early and latter portions than during the midperiod. Two stations were sampled in the Canoochee River, but no shad eggs were taken. The results of this survey indicate that the shad-spawning area in the Ogeechee River is between Kings Ferry and Midville.

Age determination from scale reading

Throughout the season, 529 scale samples were taken from tagged shad and from samples of the commercial catch. The scales were read by the method of Cating (1953). The readings revealed that the run was made up of 1.3 percent 3-year-old fish, 41.4 percent 4-year-old fish, 48.0 percent 5-year-old fish, and 9.3 percent 6-year-old fish. There were no repeaters (fish which have spawned previously) in the run. This was also found to be true of shad from St. Johns River in Florida (Sykes, Fredin, and Walburg, ms.).

Table 3.--Shad catches made at eleven sport-fishing camps between Kings Ferry and Guyton, 1954

Sport fishing camp	Number of fishermen	Number of shad caught
No 1	298	737
2	287	245
3	130	116
4	58	49
5	156	112
6	117	123
7	31	16
8	143	138
9	98	85
10	647	552
11	118	89
Total	---	2,262

Table 4.--Estimated number of shad caught by sport fishermen at State park and four landings between Brooklet and Midville

	Number times sampled	Average number of boats per day	Total fishing days in season	Total boat days in season	Average number shad per boat per day	Estimated total catch for season
State park:						
Weekdays	9	2.1	41	86.1	1.3	112
Saturdays	6	10.5	8	84.0	1.1	92
Sundays	4	6.0	8	48.0	1.3	62
Total	--	---	---	---	---	266
Spot Checks Brooklet to Midville:						
Weekdays	8	2.4	45	108.0	5.1	547
Saturdays	5	2.6	9	23.4	8.2	192
Sundays	8	2.8	9	25.2	5.5	138
Total	--	---	---	---	---	877
Total catch	--	---	---	---	---	1,143

Table 5.--Number of shad eggs collected at various stations in the Ogeechee River, 1954

Station	No. eggs
Three miles below A. C. L. trestle	0
Kings Ferry	4
Mouth Canoochee River	12
Uncle Shed's Landing	2
Rose's Fish Camp	14
Morgan's Bridge	1
Highway 80 Bridge	4
Steel Bridge	31
Brooklet Landing	20
Sherwood Trestle	5
Oliver Bridge	13
Williams Landing	17
Ogeechee Bridge	61
Rocky Ford Bridge	19
Scarboro Bridge	0
Millen	1
Herndon	0
Midville	1
Louisville	0
	205

Summary and Conclusions

At the present time the Ogeechee River is free of dams and pollution. However, textile mills are being considered in the coastal area of the river. Should they become a reality, toxic effluents and blocking of fish by a dam will become a menace to future shad populations unless the dam is provided with suitable fishways and effluent concentrations are kept below safe tolerance levels.

The results of this study indicate that the total commercial shad catch was 20,096 shad, the total population was 35,508 shad, the spawning escapement was 12,007 shad (34 percent of the population) and the overall fishing rate (exerted by commercial and sport fisheries) was 66 percent. A study of the sport fishery revealed that 3,405 shad were taken by hook and line.

Catch and effort data for years prior to 1954 are not available on the Ogeechee River. Therefore, population size and escapement for past years cannot be determined. If catch and effort records are obtained for subsequent years on the Ogeechee River the data presented in this report can be used as a basis to determine total population and escapement for each year in which records are obtained. If the factors causing fluctuations in population size can be determined and controlled, management recommendations can be made to obtain maximum yields. This type of study was made on the Connecticut River (Fredin, 1954) and Hudson River (Talbot, 1954) shad fisheries, and it is now possible to manage these fisheries scientifically.

In view of the complete absence of data which could be used as a basis for management recommendations, and the impossibility of managing this fishery without such data, it is recommended that yearly catch and effort records be obtained by the State of Georgia. When these records have been collected for a series of years, studies can proceed to determine factors affecting shad abundance in the Ogeechee River.

LITERATURE CITED

CATING, JAMES P.
1953. Determining age of Atlantic shad from their scales. U. S. Fish and Wildlife Service, Fish. Bull., No. 85, vol. 54, pp. 187-199.

CHAPMAN, D. G.
1948. Problems in enumeration of populations of spawning sockeye salmon. 2. A mathematical study of confidence limits of salmon populations calculated from sample tag ratios. Intern. Pacific Salmon Fish. Comm., Bull 2, pp. 69-85.

FREDIN, REYNOLD A.
1954. Causes of fluctuations in abundance of Connecticut River shad. U.S. Fish and Wildlife Service, Fish. Bull., No. 88, vol. 54, pp. 247-259.

GHARRETT, JOHN T.
1950. The Umpqua River shad fishery. Oregon Fish Comm. Research Briefs, 3(1): pp. 3-13.

TALBOT, G. B.
1954. Factors associated with fluctuations in abundance of Hudson River shad. U.S. Fish and Wildlife Service, Fish. Bull., No. 101, vol. 56, pp. 373-413.

INT.-DUP. SEC., WASH., D.C.